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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

<b>(51) International Patent Classification<sup>4</sup> :</b> <b>D04H 1/04</b>	<b>A1</b>	<b>(11) International Publication Number:</b> <b>WO 88/05090</b> <b>(43) International Publication Date:</b> 14 July 1988 (14.07.88)
<b>(21) International Application Number:</b> PCT/FI87/00176 <b>(22) International Filing Date:</b> 29 December 1987 (29.12.87) <b>(31) Priority Application Number:</b> 865364 <b>(32) Priority Date:</b> 31 December 1986 (31.12.86) <b>(33) Priority Country:</b> FI <b>(71) Applicant (for all designated States except US):</b> NESTE OY [FI/FI]; Keilaniemi, SF-02150 Espoo (FI).		<b>(74) Agent:</b> FORSSÉN & SALOMAA OY; Uudenmaankatu 40 A, SF-00120 Helsinki (FI). <b>(81) Designated States:</b> AT, BR, DE, GB, JP, NL, NO, SE, SU, US. <b>Published</b> <i>With international search report.</i> <i>In English translation (filed in Finnish).</i>
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<b>(54) Title:</b> NON-WOVEN FIBRE PRODUCT  <b>(57) Abstract</b>  A non-woven fibre product in which the fibre material consists, totally or in part, of fibres which are able to form bonds with natural or artificial fibres of the same or different type, and in which said fibres capable of forming bonds are cellulose carbamate fibres.		

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1 Non-woven fibre product

The invention concerns a non-woven fibre product which is totally  
5 or partially composed of fibres having bonding properties.

Non-woven fibre products are often porous materials resembling  
textiles, usually in web or sheet form, and manufactured by a  
procedure other than the spinning, weaving, knitting and braiding  
10 methods commonly employed. The fibres used in producing non-woven  
fibre products may be natural fibres or synthetic fibres, or mixt-  
ures of these. Holding together of the fibre webs may be based on  
inter-fibre bonding properties, or coherence may be achieved with  
various bonding agents, and in addition many other bonding methods  
15 may be applied in manufacturing said products, e.g bonding the  
fibres with the aid of heat or by fusing.

The present invention concerns non-woven fibre webs in which bonding  
is accomplished by using fibres which possess special bonding  
20 properties, these fibres being admixed to the fibre web that has  
to be bonded, or these fibres constituting the fibre raw material  
of the fibre product. Usually, bonding fibres used towards such a  
purpose have been fibres of synthetic origin, for instance polymer  
fibres, which have been softened, or partly fused, with the aid of  
25 chemical or heat treatment in order to achieve bonding properties.

The usability of fibres possessing bonding agent properties depends  
on the fibres to be bonded in general, on the intended use of the  
product, and on the mechanical strength properties of the product  
30 achieved with the bonding agent fibres. Fibres of cellulosic origin  
possessing bonding properties are, for instance: ground cellulose  
fibres, cellulose derivative fibres such as carboxymethyl and  
carboxyethyl cellulose fibres, and viscose fibres prepared by  
special procedures. Most of the bonding agent fibres have a nature  
35 such that they detract from the textile-resembling characteristics  
of the product. Therefore a considerable need exists in the market

1 of fibres with the aid of which fibre webs made of natural or  
artificial fibres could be bonded without incurring impaired textile  
characteristics of the products.

5 Viscose fibres are since old an important cellulose-based fibre  
which has been extensively used as fibre raw material for textile-  
type products. Among the drawbacks of viscose fibres may be noted  
inadequate wet and dry strengths of the fibre webs made of them if  
no separate bonding agents or bonding agent fibres are used. The  
10 use of viscose fibres is on the decline as a result of the above-  
mentioned reasons, among others, and moreover for the reason that  
the procedures applied in manufacturing viscose fibres comprise  
steps in which substances highly deleterious to environment are  
used. For this reason considerable need exists in the market of  
15 fibres by which could be obtained properties such as porosity,  
strength, water absorptivity, etc. Particularly, a need exists of  
fibres which yield said textile properties in fibre products which  
have been manufactured applying wet procedures.

20 The present invention concerns a fibre product which contains  
fibres possessing bonding agent properties. Bonding agent properties  
are here understood to mean that the fibres possess bonding agent  
properties in relation to another fibre, or that they possess  
bonding agent properties in relation to themselves, in which case  
25 the fibre product may even be composed exclusively of bonding  
agent fibres. In the standard case, the effect of the invention is  
best evident in the case that the fibres to be bonded have no  
inherent bonding properties. It is also possible, in forming the  
product, to make use of mechanical procedures which improve, for  
30 instance, the wet strength or dry strength of the fibre web or  
endow it with some other advantageous properties.

The object of the present invention is a non-woven fibre product  
which totally or partly consists of fibres which are able to form  
35 bonds with natural or artificial fibres of the same or different  
type. One object of the invention is a non-woven fibre product

1 which contains natural or artificial fibres devoid of binding  
properties and fibres possessing bonding properties. One further  
object of the invention is to accomplish a non-woven fibre product  
in which conventionally used and previously known natural or arti-  
5 ficial fibres embarrassed by drawbacks have been totally or partly  
replaced with fibres having no equivalent drawbacks and which  
furthermore are able to establish bonds with natural or artificial  
fibres and of which webs can be manufactured on a paper machine.

10 The non-woven fibre product of the invention of which the fibre  
material totally or partly consists of fibres which are able to  
form bonds with natural or artificial fibres of the same or differ-  
ent type is characterized in that said fibres able to form bonds  
are cellulose carbamate fibres.

15

The present invention affords a number of substantial advantages.  
Firstly, cellulose-based artificial fibres commonly used in manu-  
facturing non-woven fibre products, such as viscose rayon fibres,  
may be totally or partly replaced with cellulose carbamate fibres.

20 By replacing viscose fibres, partly or totally, sufficiently strong  
products are obtained altogether without using separate bonding  
agents. The possibility of replacing viscose fibres is an advantage  
already in itself because the viscose fibre manufacturing process  
is highly unfriendly to the environment, and therefore a need  
25 exists to replace these fibres. Polypropylene fibre is another  
conventionally used fibre quality which has no strength properties  
in the absence of bonding effected with bonding agents or by fusing.

As taught by the invention, it is possible to replace advantageously  
30 part of the fibres in non-woven fibre webs, for instance 1-90%,  
with cellulose carbamate fibres, which are able to form bonds with  
the other fibres in the fibre product. That alternative is also  
within the sphere of the invention according to which the fibre  
material of the fibre product is totally replaced with cellulose  
35 carbamate. In manufacturing the fibre web, any typical procedure  
applied in manufacturing non-woven webs may be applied, such as wet

1 procedures, water knitting procedures, etc. Webs may also be formed  
by carding or by other dry procedures and the webs may be bonded  
by humidifying. If needed, other auxiliary substances may be added  
to the web, such as wet-strong resins, fillers, etc.

5

In the examples following below, the following fibres were used in  
manufacturing non-woven fibre webs:-

Cellulose fibres: pine sulphate cellulose fibres, ground in a  
10 laboratory hollander to fineness 20 °SR. The fibres were stored in  
wet condition between grinding and fibre sheetforming.

Viscose fibres: 1.7 dTex, length 6 mm (manufactured by company  
Säteri Oy), having the following characteristics:-

- |    |                    |                          |                            |
|----|--------------------|--------------------------|----------------------------|
| 15 | - Strength         | in air-conditioned state | min. 1.8                   |
|    |                    | in wet condition         | min. 0.9                   |
|    | - elongation       | in air-conditioned state | max. 25%                   |
|    |                    | in wet condition         | max. 32%                   |
|    | - Water inhibition |                          | 18-20 g H <sub>2</sub> O/g |
| 20 | - Ware retention   |                          | 100-110%                   |

The carbamate fibres used in the examples had been laboratory spun  
from cellulose carbamate which had been prepared from bleached  
cellulose and which had been irradiated with electron beam treat-  
25 ment to make the cellulose have DP = 470. The cellulose was impreg-  
nated with an impregnating solution containing ammonia 58 % by  
weight, water 26% by weight and urea 16% by weight. After impreg-  
nation, the ammonia was removed by evaporation, and the urea-  
impregnated fibres were heat-treated at 140°C, during 3 hours. The  
30 cellulose carbamate fibres thus obtained had the following charac-  
teristics:-

	Nitrogen content	2.6-2,9% N
	DP	280-290
35	Clogging number (-5°C)	220-345
	Ball viscosity (20°C)	3.6-4-4 Pas

- 1 A spinning solution was prepared of the carbamate fibres, containing 7.3% by weight of cellulose carbamate manufactured as described above, 8% by weight sodium hydroxide and 0.5% by weight zinc oxide. The fibres were spun from this solution into sulphuric acid/sodium sulphate solution containing sodium sulphate 79-80 g/l and zinc 10.8 g/l. The fibres thus spun presented the following characteristics, after neutralizing and washing:-

	Nitrogen content	2.18% N
	dtex	1.5
10	Strength	2.25 cN/dtex
	Elongation	8.6%

#### Example 1

- 15 A comparison was made of non-woven fibre products containing cellulose fibres and viscose fibres, respectively cellulose carbamate fibres, made in a sheet mould. The weight per square metre of the sheets thus obtained averaged 60 g/m<sup>2</sup>. The strength characteristics of the fibre products thus obtained are presented in Table 1.

20

Table 1

	CELL	VISC	CARB	Dry tensile strength,	Elongation,	Wet tensile strength,	Wet elongation
25	%	%	%	MPa	%	MPa	%
	75	-	25	20.1	3.1	0.95	2.5
	75	25	-	16.7	3.6	0.57	3.2
	67	-	33	18.9	3.3	0.94	2.9
30	67	33	-	13.0	3.3	0.46	3.5
	50	-	50	12.5	2.7	0.72	2.6
	50	50	-	5.6	2.5	0.30	3.7
	33	-	67	18.9	3.3	0.94	2.9
	33	67	-	10.8	2.4	0.62	2.4

35

CELL = Cellulose VISC = Viscose CARB = Cellulose carbamate

- 1 The results in Table 1 show that by using cellulose carbamate  
fibres one obtains substantially better strength characteristics  
than by using viscose fibres; therefore, viscose fibres are advan-  
tageously replaceable with cellulose carbamate fibres, and better  
5 strength characteristics are obtained in addition.

### Example 2

- Such non-woven fibre products made in a sheet mould were compared  
10 in which the fibres were mixtures of viscose fibres and cellulose  
carbamate fibres. The average weight per square metre of the sheets  
was 29.6 g/m<sup>2</sup>. The strength characteristics of the fibre products  
thus obtained are presented in Table 2.

15

Table 2

CELL	VISC	CARB	Dry tensile strength,	Elongation,
%	%	%	MPa	%
20 -	-	100	12.8	1.4
-	50	50	2,38	0.6
-	80	20	0.37	0.5

CELL = Cellulose VISC = Viscose CARB = Cellulose carbamate

25

Table 2 reveals that the higher the proportion of viscose fibres  
replaced, as taught by the invention, with cellulose carbamate  
fibres, the better the strength characteristics that will be ob-  
tained.

30

### Example 3

- The influence on the strength characteristics of non-woven sheets  
made of cellulose carbamate fibres elicited with wet-strong resin  
35 was studied. The sheets had average weight per m<sup>2</sup>, 33 g/m<sup>2</sup>. Wet-  
strong resin of "Kymmene 558" brand was added to the cellulose



1 fibres at 1% by weight, followed by heating for 1 hour. The strength  
characteristics of the products thus obtained are presented in  
Table 3.

5 Table 3

	Temperature	Wet tensile strength,	Wet elongation,	Dry tensile strength,	Dry elongation,
		MPa	%	MPa	%
10					
	20	0.40	1.8	8.7	0.9
	105	1.07	3.4	9.9	1.1
	130	1.33	4.1	11.9	1.5
15	140	1.95	5.3	12.1	1.6

The results show that conventionally used additives increasing the  
wet strength are also usable when bonding agent fibres according  
20 to the invention are being used.

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## 1 Claims

1. A non-woven fibre product in which the fibre material consists totally or partly of fibres which are able to form bonds with  
5 natural or artificial fibres of the same or different type, characterized in that said fibres capable of forming bonds are cellulose carbamate fibres.

2. Non-woven fibre product according to claim 1, characterized in  
10 that said natural fibres have been selected from the group: cellulose, hemp, wool, cotton.

3. Non-woven fibre product according to claim 1, characterized in  
15 that the artificial fibre has been selected from the group: viscose, cellulose acetate, polypropylene, polyester, polyamide.

4. Non-woven fibre product according to any one of the preceding  
20 claims, characterized in that it contains, in addition, wet-strong resin.

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# INTERNATIONAL SEARCH REPORT

International Application No PCT/FI87/00176

<b>I. CLASSIFICATION OF SUBJECT MATTER</b> (if several classification symbols apply, indicate all) <sup>6</sup> According to International Patent Classification (IPC) or to both National Classification and IPC 4 <div style="margin-left: 40px;">D 04 H 1/04</div>						
<b>II. FIELDS SEARCHED</b> <div style="text-align: right; margin-right: 100px;">Minimum Documentation Searched <sup>7</sup></div> <table style="width: 100%; border-collapse: collapse;"> <tr> <th style="width: 20%; border-bottom: 1px solid black;">Classification System</th> <th style="border-bottom: 1px solid black;">Classification Symbols</th> </tr> <tr> <td style="border-right: 1px solid black; padding: 5px;">IPC 4</td> <td style="padding: 5px;">D 04 H 1/00-/14, /40-/44; D 21 F 11/14; D 21 H 5/26; C 08 B 15/06 <div style="text-align: right;">.../...</div></td> </tr> </table> <div style="text-align: center; margin-top: 10px; font-size: small;">Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched <sup>8</sup></div>			Classification System	Classification Symbols	IPC 4	D 04 H 1/00-/14, /40-/44; D 21 F 11/14; D 21 H 5/26; C 08 B 15/06 <div style="text-align: right;">.../...</div>
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IPC 4	D 04 H 1/00-/14, /40-/44; D 21 F 11/14; D 21 H 5/26; C 08 B 15/06 <div style="text-align: right;">.../...</div>					
<div style="text-align: center; margin-top: 20px;">SE, NO, DK, FI classes as above</div>						
<b>III. DOCUMENTS CONSIDERED TO BE RELEVANT <sup>9</sup></b>						
Category <sup>10</sup>	Citation of Document, <sup>11</sup> with indication, where appropriate, of the relevant passages <sup>12</sup>	Relevant to Claim No. <sup>13</sup>				
X	WO, A1, 83/03433 (NESTE OY) 13 October 1983 See spec. p. 2, r. 30-37 & EP, 0103618 US, 4583984 CA, 1205958	1-4				
A	TAPPI Int. Dissolving Specialty Pulps Conf. Proc., Boston, April 5-8', 1983, 99-104, Ekman K et al: "Fibres by wet spinning of cellulose carbamate solutions"					
<div style="display: flex; justify-content: space-between; font-size: x-small;"> <div style="width: 45%;"> <p>* Special categories of cited documents: <sup>10</sup></p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> </div> <div style="width: 45%;"> <p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step</p> <p>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.</p> <p>"A" document member of the same patent family</p> </div> </div>						
<b>IV. CERTIFICATION</b>						
Date of the Actual Completion of the International Search <div style="text-align: center; margin-top: 10px;">1988-04-08</div>		Date of Mailing of this International Search Report <div style="text-align: center; margin-top: 10px;">1988 -04 11</div>				
International Searching Authority <div style="text-align: center; margin-top: 10px;">Swedish Patent Office</div>		Signature of Authorized Officer <div style="text-align: center; margin-top: 10px;">               Liisa Hyrkäs           </div>				

Form PCT/ISA/210 (second sheet) (January 1985)

## FURTHER INFORMATION CONTINUED FROM THE SECOND SHEET

II

Fields searched (cont)

US C1 19: 144-163, 296-308;  
 28: 101-139;  
 156: 167-181, 433-441;  
 264: 109-128, 187-194;  
 428: 85-115, 224-303

V. ☐ OBSERVATIONS WHERE CERTAIN CLAIMS WERE FOUND UNSEARCHABLE <sup>1</sup>

This international search report has not been established in respect of certain claims under Article 17(2) (a) for the following reasons:

1. ☐ Claim numbers \_\_\_\_\_, because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claim numbers \_\_\_\_\_, because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claim numbers \_\_\_\_\_, because they are dependent claims and are not drafted in accordance with the second and third sentences of PCT Rule 6.4(a).

VI. ☐ OBSERVATIONS WHERE UNITY OF INVENTION IS LACKING <sup>2</sup>

This International Searching Authority found multiple inventions in this international application as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims of the international application.

2. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims of the international application for which fees were paid, specifically claims:

3. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claim numbers:

4. ☐ As all searchable claims could be searched without effort justifying an additional fee, the International Searching Authority did not invite payment of any additional fee.

## Remark on Protest

☐ The additional search fees were accompanied by applicant's protest.

☐ No protest accompanied the payment of additional search fees.